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ABSTRACT

Ways in which elementary school teachers can encourage children's maintenance and generalization of memory strategies were investigated. Questions guiding the research were: Does the teacher (1) Repeat strategy suggestions frequently? (2) Give a rationale for strategy use or feedback concerning the effectiveness of the strategy? and (3) Attempt to promote strategy generalization? Attention was also given to describing differences over grade level in the use of repetition, rationale-giving, and generalization instruction by teachers. A group of 69 teachers from public school classrooms of grades kindergarten through 6 were observed according to a time-sampling scheme for 30 minutes per day on five days as they taught language arts and mathematics. A total of 292 strategy suggestions were recorded in a written narrative and were classified into 12 categories having to do with rote learning, elaboration, attention, specific attentional aids, transformation, deduction, exclusion, imagery, specific aids for problem solving and memorizing, general aids, self-checking, and metamemory. Findings indicated that repetition of strategy suggestions did occur among teachers of all grade levels, rationales for strategy use are given more frequently at higher grades, and instructions that promote strategy generalization, which should be particularly effective in the classroom, were rarely seen. Implications for teacher education are pointed out. (RH)

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An Investigation of How Teachers Establish Stable Use and Generalization of Memory Strategies through the Use of Effective Training Techniques

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An Investigation of How Teachers Establish Stable Use and Generalization of Memory Strategies through the Use of Effective Training Techniques

Descriptions of developmental changes in memory strategy use and in children's metacognitive understanding of memory processes have been elaborated in recent years. Although it is clear that memory processes show important developmental changes and that appropriate training experiences facilitate performance, influences from the child's own environment on the development of memory and metamemory skills are only now being investigated. In our work, we have focused on the elementary school classroom as a setting in which children may acquire and refine memory skills, gain metacognitive understanding of memory and factors influencing it, and learn how to monitor and regulate their own memory activities toward the goal of effective learning.

In previous work (Hart, Leal, Burney, & Santulli, 1985; Moely, Hart, Santulli, Leal, Johnson-Baron, Rao, & Burney, in press), we described the kinds of strategy suggestions teachers make during instruction in elementary school classrooms. The present study examined ways in which teachers may encourage children's maintenance and generalization of strategies. We relied upon the research literature to identify three potentially facilitating procedures that teachers could be using to encourage strategy use, and investigated the extent to which teachers actually employed these procedures when they gave strategy suggestions.

One training operation that has sometimes been shown to produce strategy maintenance is that of increasing the number of instructional

trials. Turnure and Thurlow (1973), for example, showed that even retarded children can successfully transfer a trained paired-associates strategy with relatively extensive strategy training. Borkowski, Cavanaugh, & Reichhart (1978) showed that extent of training influenced maintenance and generalization of a cumulative-cluster strategy by third- and fourth-grade children. Thus, we might expect that teachers' frequent repetition of suggestions about strategy use would be of value in promoting children's strategic behaviors.

A second manipulation that has been shown to facilitate both maintenance and transfer of a trained strategy is the provision of explicit metamemory information concerning the usefulness of the strategy (by giving a rationale for strategy use or giving feedback about strategy effectiveness). Kennedy and Miller (1976), for instance, found that 6 to 7-year-old children given rehearsal strategy training were more likely to maintain strategy use on a serial recall task if they had been given feedback about the strategy's value in improving their recall. Similar findings for a free recall task were reported by Ringel & Springer (1980). Therefore, we were interested in the extent to which teachers would provide such information when suggesting strategies for learning and memory.

A third procedure that might be expected to improve generalization of a trained strategy to new situations is instruction that explicitly teaches generalization by informing or demonstrating to the child that the strategy can be used in other learning situations. Training studies including generalization components have been successful in demonstrating strategy transfer (Belmont, Butterfield, & Borkowski,

1978; Kramer & Engle, 1981), so it is to be expected that teachers' use of generalization instructions should be beneficial to children's strategy use. Our conceptualization of generalization also included situations in which the teacher might suggest some change in or elaboration of the strategy itself. This latter aspect is somewhat analogous to the learning theory concept of "response generalization," while the first aspect of generalization described above is more similar to a learning theory notion of "stimulus generalization." We were interested in the relative use of these two kinds of generalization instruction in the classroom situation.

Questions guiding the research, then, were the following: 1) Does the teacher repeat strategy suggestions frequently, so that the child has several opportunities to learn to use the strategy? 2) Does the teacher give a rationale for strategy use or feedback concerning the effectiveness of the strategy when encouraging children's memory efforts? 3) Does the teacher attempt to promote strategy generalization, either through specific instructions about how the strategy might be generalized to new situations or used in new ways, or through instructions that encourage the child to broaden and elaborate the manner in which the strategy is executed? 4) Finally, because of our interest in developmental changes, we also wanted to describe differences over grade level in the use of repetition, rationale-giving, and generalization instruction by teachers.

We observed a group of 69 teachers, from public-school classrooms of grades K through 6, as they taught language arts (reading, spelling, language activities) and mathematics. Teachers were divided for

analysis into a lower grades group (17 kindergarten and first-grade teachers), an intermediate grades group (24 second- and third-grade teachers), and a higher grades group (28 fourth-, fifth-, and sixth-grade teachers). All of the teachers were working in public schools in the New Orleans area, with approximately one-third from the urban center of the city and two-thirds from nearby suburban areas. Teachers had spent an average of 8.44 years teaching at the grade at which they were observed in this project, and had spent an average of 14.9 years teaching. An average of 11.32 years had elapsed since they last attended college classes. Approximately 42% of the group had pursued graduate training. These indices did not show differences among teachers at the different grade levels included in the study.

Each teacher was observed for 30 minutes per day, on five different days, using a time-sampling scheme to record teaching activities. Strategy suggestions were recorded in a written narrative, as were efforts by teachers to suppress children's spontaneous strategy use. For purposes of this research, a strategy was defined as a voluntary activity that children could employ toward the goal of learning or remembering information. Teachers varied widely in the frequency with which they made strategy suggestions, with an average of 4.23 strategies observed for each teacher. Ten percent (N = 7) of the sample produced no such suggestions. As we have reported previously (Hart, et al., 1985), teachers of grades 2-3 were more likely than those at lower or higher grade levels to give strategy suggestions. It was possible to reliably classify the 292 narrative descriptions of teachers' suggestions for strategy use into 12 categories (Table 1). These

categories included rote learning activities, varieties of elaborative, meaning-based strategies, as well as some very general, self-regulatory strategies.

For the present study, observational records and narratives describing the 292 strategy suggestions were examined in order to determine how often teachers engaged in the "facilitating" activities described above. First, repetition of strategy suggestions was coded by counting the number of 10-s observation intervals in which the teacher was scored as having given the same strategy suggestion, either within or across observation periods. The number of suggestions made ranged from 1 to 17 repetitions. The highest score among teachers at the lower grade level was shown by a first-grade teacher who gave 13 repetitions of a strategy suggestion that involved use of a "number ladder" to solve simple addition problems. At second grade, a teacher instructing techniques for learning spelling words repeated the simple rote strategy of spelling the word aloud on 12 occasions. At fifth grade, a teacher suggested ways to use Cuisenaire rods for solving problems involving proportional relations on 17 occasions during an observation. These are not typical examples, however. Overall, teachers averaged only 1.81 repetitions per strategy. Another way of representing this information is to note that of the total set of <u>unique</u> strategy suggestions made by teachers, 44% were observed to occur more than a single time within or across observation periods. Teachers of different grade levels did not vary significantly in their tendency to repeat strategy suggestions. We had thought that teachers of younger children might use repetition to a greater extent than teachers of older children, but this was not the

case. A limitation of these observations, of course, is that strategy suggestions may have been repeated at times when the observers were not present.

The second step in analysis was to determine, for each unique strategy, whether the teacher gave a rationale for the use of the strategy or offered feedback concerning the way in which the strategy might improve performance. Each teacher received a score indicating the proportion of all of his/her suggestions that were accompanied by rationale/feedback statements. There was a significant increase across grade level in the teachers' use of such statements, $F(2,59) = 5.28$, $p = .0078$. Statistical tests of the means indicated that the teachers of the highest grade level (4th and above) were significantly higher in the use of rationale/feedback statements ($M = .45$) than were either the lower grades group ($M = .14$) or the intermediate grades group ($M = .29$). Another way of demonstrating this difference is to examine the proportion of strategy suggestions at each grade level that were accompanied by rationale/feedback statements: At the kindergarten/first-grade level, about 21% of all strategy suggestions were accompanied by a rationale or feedback statement; this increased only to 30% at the second/third-grade level, while at grade four and above, nearly half (48%) of all strategy suggestions included some statement concerning the value or usefulness of the strategy for more effective learning, remembering, or problem-solving. This grade difference seems to reflect a sensitivity on the part of teachers to the developing metacognitive ability of students during the elementary school years. Research on memory-metamemory connections often reveals a stronger relationship

between these two domains at the higher elementary levels (Borkowski, Peck, Reid, & Kurtz, 1983; Cavanaugh & Borkowski, 1980; Kurtz & Borkowski, 1984; Schneider, 1985; Wimmer & Tornquist, 1980). Therefore, research provides some justification for a finding of greater provision of metacognitive information for children at higher developmental levels.

Finally, data were examined for instances in which teachers specifically instructed generalization of a strategy. It was disappointing to find that there were only 19 instances in which teachers were judged to be instructing generalization. Most of these involved pairs of strategy suggestions that indicated two situations in which a strategy could be used (e.g., a rote memory procedure of writing spelling words repeatedly and writing multiplication facts over and over as a way to learn them; using textbook illustrations in two different lessons in order to help understand math problems, etc.). Very few instances of what we had termed "response generalization" were seen. The few that did occur involved variations in strategies for writing words as a way to remember them (writing "in the air" or on paper) or variations in procedures used in applying a self-checking strategy. Approximately 23% of the teachers made one or more generalization attempts; these teachers were quite evenly distributed across grade levels. Because teachers' strategy suggestions are usually quite task-specific and address a wide range of content areas, it is perhaps not surprising that so little instruction in generalization occurs. However, in light of the research literature, it is also disappointing that teachers do not make more frequent efforts to encourage children's

use of strategies in new task situations.

We were also interested in the extent to which teachers varied in their use of these three procedures (repetition, rationale-giving, and generalization instructions) when suggesting different kinds of strategies (Table 1). However, because of the low frequency of occurrence of strategy suggestions in the 12 categories, it was not possible to conduct statistical comparisons to test differences by category. Examination of the data indicates that both repetition and rationales were often provided for transformation strategies, which are used primarily in mathematics instruction and involve a reorganization or logical reconceptualization of the math problem into a more familiar form for the student. Repetitions were also relatively frequent for the use of specific aids for problem solving, while rationales were often given along with suggestions about attentional strategies and the use of imagery. The few instances of generalization instruction did not differ by category.

In summary, then, we find that repetition of strategy suggestions does occur among teachers of all grade levels. Of the three procedures that we have considered here, repetition is the least certain to provide necessary tools to the child for subsequent strategy maintenance and generalization. Although several studies cited above showed beneficial effects of extended training, other studies (e.g., Gruenenfelder & Borkowski, 1975; Wanschura & Borkowski, 1975) did not. Second, rationales for strategy use are given more frequently at higher grades. While this may reflect teachers' sensitivity to children's abilities, as suggested above, the low frequency of rationales or feedback given young

children is somewhat discouraging. Research has shown facilitative effects of providing rationales and feedback about strategy use to children at the early elementary grades (Kennedy & Miller, 1976; Ringel & Springer, 1980). Third, instructions that promote strategy generalization should be particularly effective in the classroom, but are rarely seen.

A general implication of these findings is that greater efforts should be made in teacher training programs to include units on the development of memory and factors affecting that development, including specific notions of how research findings can be translated into classroom practice. Among the teachers participating in the present study, those who frequently offered strategy suggestions were more likely than others to have recently taken college courses. Also, those more recently in school were more likely to report exposure to topics of memory development and training and metacognition. In workshops we have conducted subsequent to this research, teachers have been very responsive to suggestions about ways to encourage maintenance and generalization of strategies. They have expressed particular interest in learning how their teaching might facilitate children's metamemory and self-regulation of memory activities for classroom learning situations, topics that we know are important but that have rarely been emphasized in teacher training.

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Table 1. Classification of Teachers' Strategy Suggestions

1.) Rote Learning (10.3% of all suggestions made)

Rote learning strategies are instructed for simple repetitive learning. Children are told to rehearse stimuli verbally, or to write, look at, go over, study or repeat them in some other way. The children may be instructed to rehearse items just once, a finite number of times, or an unlimited number of times. Rote learning strategies do not include any explicit activities that would add meaning to the stimulus or cause it to be processed to a deeper level or in terms of more extensive associative relationships.

2.) Elaboration (8.6%)

The elaboration strategy is instructed for use with stimulus materials that generally do not have much intrinsic meaning to children, such as the definition or pronunciation of words, etc. Children are instructed to use elements of the stimulus material and assign meaning by, for instance, making up a phrase or sentence, making an analogy, or drawing a relationship based on specific characteristics found in the stimulus material.

3.) Attention (12%)

These strategies are suggested by teachers to direct or maintain children's attention to a task. For example, teachers may instruct children to "follow along" or "listen carefully" during lessons.

4.) Specific Attentional Aids (7.9%)

This strategy is similar to the attention strategy, but children are instructed to use objects, language, or a part of their body in

a specific way to maintain orientation to a task. Although these aids are employed in a specific way for the attentional task, they may have other uses ordinarily.

5.) Transformation (6.8%)

Transformation is a strategy suggested by teachers for transforming unfamiliar or difficult problems into familiar or simpler ones that can then be solved more easily. Transformations are possible because of logical, rule-governed relationships between stimulus elements. Teachers identify these relationships and tell children either that a problem can be rewritten, or that it can be reformulated if the method of solution is related or derived from rules and procedures learned previously. Due to the emphasis on logical, rule-governed relationships, this strategy is usually suggested in mathematics.

6.) Deduction (11.3%)

In deduction, children are instructed to use their general knowledge, in combination with any clue from the material that seems helpful, to deduce and construct the correct answer. Teachers might direct children to use contextual information (e.g., pictures accompanying a text, or parts of the text), or to analyze the item into smaller units (e.g. looking for root words, analyzing words phonetically).

7.) Exclusion (3.1%)

This is a strategy to help children answer test or workbook questions even if they don't know the correct answer initially. Children are told to eliminate incorrect options systematically,

either by (1) doing the problems they know first, then trying to match questions and answers that are left over; or by (2) trying out all possibilities and selecting the one that seems correct.

8.) Imagery (3.8%)

This strategy usually consists of non-specific instructions to remember items by taking a mental picture of them, or to maintain or manipulate them in the mind. It also refers to visualizing procedures or characters.

9.) Specific Aids for Problem Solving and Memorizing (15.4%)

This strategy involves the use of specific aids in problem-solving or memorizing. Even though these aids may have other uses, the teacher instructs one specific application of them. Teachers may give explicit instructions on how to use the aids in the task at hand. Thus, children are instructed to use objects, food items, body parts, or assigned reading materials in learning and memory tasks. For example, teachers often told children to use blocks or other counters to represent addition or subtraction operations in a concrete way.

10.) General Aids (6.8%)

In contrast to specific aids, teachers recommend the same general aid for a variety of different problems. These aids are designed and used to serve a general reference purpose. Children often have prior training in their use and — once familiar with them — are expected to utilize them without further explanation. Examples include the use of dictionaries or other reference works.

11.) Self-checking (8.2%)

Teachers instructing this strategy suggest to children to check their work for errors before turning it in. It includes procedures children can use on their own to make sure they are doing a task correctly. Teachers may also suggest that children test themselves or have someone else test them. Or, children might be encouraged to keep track of all steps involved in a task, so that they can later identify where they made a mistake. The instructions for this strategy are often not specific, but rather a general remark to "check" the work.

12.) Metamemory (5.8%)

Teachers instructing this strategy tell children that certain procedures will be more helpful for studying and remembering than others, and sometimes teachers may also explain why this is so. The strategy frequently includes giving hints about the limits of memory, asking children about the task factors that will influence ease of remembering, or helping them understand the reasons for their own performance. Teachers may ask children how they can focus memory efforts effectively, or what they can do to remember. Teachers also tell children that they can devise procedures that will aid their memory, or indicate the value of using a specific strategy.

Table 2

Number of Instances in Which Each Strategy Suggestion Was Observed Among Teachers At Each Grade Level

	Grade Level			
	K-1	2-3	4-6	All Grades
n =	17	24	28	69
Category				
Rote	4	14	12	30
Elaboration	5	12	8	25
Attention	9	19	7	35
Attentional Aid	9	13	1	23
Transformation	3	10	7	20
Deduction	7	15	11	33
Exclusion	4	2	3	9
Imagery	2	9	0	11
Specific Aid	19	19	7	45
General Aid	2	7	11	20
Self-checking	3	11	10	24
Metamemory	1	9	7	17
Total Number of Strategies	68	140	84	292
Mean Number of Strategies	4.00	5.83	3.00	4.23